6.5 Motor Vehicle Circulation

introduction

This section describes a policy approach to capital investments for motor vehicle circulation in Boulder.

level of service objectives

The 1989 TMP established a goal of maintaining at least Level of Service D on all arterial roadways in Boulder. The 1989 TMP acknowledged some roadways would operate in congestion conditions during peak hours, a fact that has become more evident in this Update. All of the future scenarios evaluated as part of the TMP Update resulted in some portion of the roadway system being congested. The percentage of roadways (all streets except local access and neighborhood streets) operating at Level of Service F in 2020 ranged from just under 20% in Scenario D to over 60% in Scenario B. (Figure 6-41 on the following page describes LOS A through F for motor vehicles.)

For over fifty years, the traditional approach to addressing congestion has been to increase the supply of vehicular infrastructure -- building new roadways, adding through lanes, building interchanges, etc. Supply-side solutions to congestion may be inappropriate for several reasons:

(1) the required construction is costly and funding is needed for other purposes;

(2) streets occupy most or all of the available public right-of-way and further expansion involves environmental impacts as well as effects on adjacent properties which neighborhoods find unacceptable;

(3) there is a widely-held public perception that adding capacity encourages increased traffic (figure 6-40) which is undesirable due to negative impacts of that traffic; and,

(4) adding lanes and certain other kinds of improvements makes streets greater obstacles to walking and biking.

If daily vehicle traffic in Boulder Valley continues to grow, then adding throughput capacity to Boulder's streets will not permanently correct congestion problems and will lead to the effects described above.

Further, as the 1989 TMP pointed out, adding capacity to our streets would work against the City's efforts to reduce single-occupant vehicle travel by shifting trips to other modes.

figure 6-40. historic experience with roadway investments

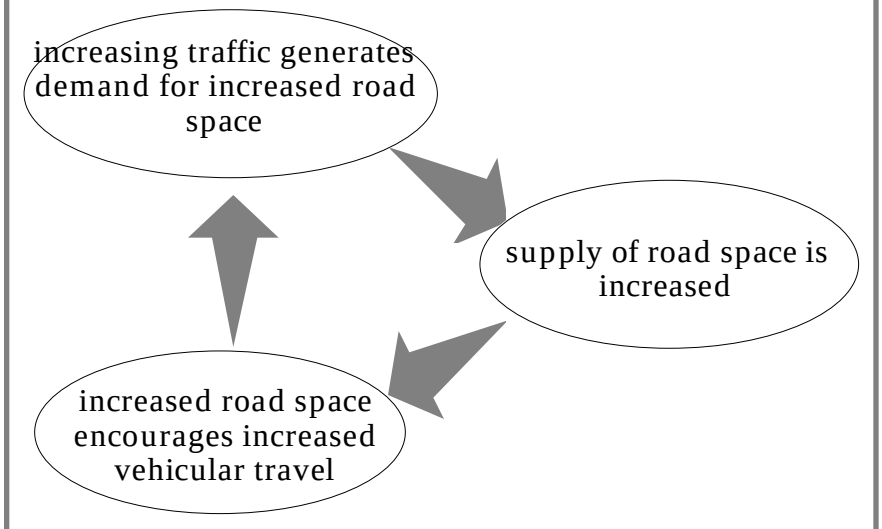


figure 6-41. roadway level of service -- "LOS"(for motor vehicles)

LOS A

Free-flow conditions with low traffic density. Even during peak periods, not all of the green time allocated to a direction will be needed to clear the cars queued in that direction. Example: 19th and Iris.

LOS

Stable traffic conditions with little or no delay. The green time allowed for any direction is more than is fully needed to clear the cars queued in that direction, and no vehicle waits longer than one red light. Example: 30th and Iris.

LOS C

Vehicle movements (e.g., ability to change lanes) somewhat restricted during peak periods due to high volumes. The green time allocated to any direction is often needed to clear the cars queued in that direction, and during peak periods not all of the vehicles can clear -- drivers may wait through more than one signal cycle. Example: Broadway and Balsam.

LOS D

Limits of stable operations are reached. Delays may be substantial during brief portions of peak periods. However, there are enough cycles with lower demand to permit clearance of the queues of waiting vehicles and to prevent long, enduring backups. Example: Broadway and Baseline.

LOS E

Traffic volumes reach capacity of the roadway's intersections; vehicle movements are restricted by the presence of other vehicles; long queues and delay at signals is experienced during peak travel periods, and it normally will take more than one cycle for a driver to clear the intersection during peak periods. Example: Broadway and Canyon.

LOS F

Traffic demand during peak period exceeds capacity of the roadway's intersections, causing stop and go conditions and excessive delay at signals; severe congestion occurs during peak periods with long queues of waiting vehicles at traffic signals. Example: 28th and Arapahoe.

However, there are also arguments for making roadway investments. They include:

(1) the public is frustrated about congestion; it is one of the items people cite as an issue they expect the City to address;

(2) congested roadways can give rise to safety problems, such as an increase in rear-end collisions where cars are queued behind other cars waiting for a break in traffic to make left turns;

(3) increasing roadway capacity may sometimes provide short-term relief - traffic will flow more freely for varying numbers of years before the roadway again reaches congestion conditions;

(4) congestion on arterial and collector streets can increase cut-through traffic on local streets as drivers avoid delays by taking "short-cuts" through neighborhoods; and,

(5) the perception that traffic is bad may have economic consequences if shoppers and employers begin to look for other less-congested retail destinations and employment sites within the region.

The need to decide when investments in roadway infrastructure are desirable represents a difficult policy issue.

One way to shed light on this issue is to examine the many functions our public streets perform.

Boulder's public streets are:

- owned and shared by the public;
- our largest infrastructure investment;
- the space where more interpersonal interactions occur each day than in any other place; and,
- the primary infrastructure for all modes of travel.

Figure 6-42 below provides a list of functions that the Boulder street network serves. It is important that the street system perform all of these functions well. Continually adding capacity to address congestion may prevent performance of other functions. However, not addressing congestion may prevent performance of certain functions - such as efficient transit service or safe pedestrian crossings.

figure 6-42. uses of the public street space

public mobility

> walking
> bicycling
> personal vehicle travel
> transit buses
> truck freight distribution

public access

> walking
> bicycle parking
> auto parking
> transit shelters and centers
> delivery parking

public services

> police
> fire
> rescue

public & private utilities

> stormwater drainage
> water
> sewer
> telephone
> natural gas
> electrical power
> TV cable
> fiber optic cable

community

> meeting - greeting
> walking, biking, skating
> community appearance
> gateways and vistas

The 1989 TMP addressed this by identifying a need to ". . . design the transportation system in a manner which balances the needs of all modes . . ."

Because all modes rely on essentially the same infrastructure - the public streets, balancing the needs of all modes requires applying a functional approach to system investments. In some cases, vehicular congestion may impede the mobility of transit buses and pedestrians. And in some cases, roadway investments are needed to support the City's land use plan. In other cases, adding roadway capacity would reduce mobility for bicyclists or pedestrians.

To provide a systematic means of evaluating these and other competing needs, the City will use the program definitions shown in Figure 6-43.

figure 6-43. functional program definitions

system preservation

Work required to protect public investment in existing infrastructure so that the value of public transportation infrastructure does not decline.

travel safety

Improvements required to correct known or potential safety problems with existing infrastructure and programs to improve public awareness and safe travel behavior.

functional efficiency

Improvements to operational efficiency of one or more modes which do not decrease the efficiency or safety of other modes and which make existing infrastructure more efficient through low-cost investments. Does not include through-lanes or interchanges.

functional capacity

Addition of capacity for one or more modes including new facilities, lane additions, and separations.

quality of life

Neighborhood traffic mitigation program, landscaping, and aesthetics.

These program definitions will be applied across all modes. For example, investments in system preservation could include roadway resurfacing as well as multi-use path maintenance or sidewalk repair.

Most functional efficiency needs - for all modes - are found at roadway intersections, where the conflicts between modes and between users of the same modes, must be worked out in part through design.

The functional program description has been used to analyze actual transportation program expenditures to determine what the recent spending pattern has been.

During the five years from 1990 through 1994, the City of Boulder invested about $69 million in its transportation system. The breakdown of this program was as follows:

- system preservation: 33%
- travel safety: 29%
- functional efficiency: 17%
- functional capacity: 14%
- quality of life: 7%

Thus, less than one-sixth of the City's transportation investments during this period were for the purpose of increasing capacity for any mode. This is a trend that will continue unless major new sources of funding are found and applied to transportation needs. (The above allocation is compared with the proposed future program in Chapter 8.)

1989 TMP projects

The 1989 TMP identified a total of over 35 roadway improvement projects "required by the year 2010." These were shown in two tables:

- Table 2.5 projects which were needed for already-existing deficiencies; and,
- Table 2.6 which listed projects for which a need was anticipated by 2010.

The rationale developed by the TMP was:

- projects addressing existing needs were the responsibility of the community and would be funded through the Transportation Fund; and,
- projects addressing future needs were attributed to growth. These were to be funded from a Transportation Excise Tax. The 1989 TMP states "the Transportation Fund will no longer be used to fund projects to accommodate growth."

TABLE 6-1. REVIEW: 1989 TMP TABLE 2.5
"PROJECTS REQUIRED TO MODIFY THE EXISTING STREET SYSTEM"

{based on 1989 TMP Table 2.5}	**Original Justification**	**Project Status And/Or Resolution**
Broadway, Regent to Iris-Reconstruct, add turn lanes	LOS, structural deficiencies	Partially complete, remainder has been reassessed (Chapter 7)
Table Mesa, Broadway to Moorhead Rebuild Boulevard, same laneage	Congestion, safety, need for alt. modes.	Project scope revised (See Chapter 7)
Araphoe / Foothills Intersection	LOS, safety	DONE
Valmont, 47th to 55th - add 2 lanes	LOS	REVISED PLAN, DONE
28th St, Valmont to Iris - Median, access control and accel / decel lanes	LOS, safety, operations	Programmed in 96, 97, 98 revised scope in Chapter 7
U.S. 36 bridge widening at Boulder Creek	LOS	Programmed in 97
Arapahoe / 28th Intersection	LOS	DONE
55th, Baseline to Arapahoe - add one lane	LOS	In study stage programmed in 96
Arapahoe, Cherryvale to 63rd - add two lanes	LOS	Programmed in 97, Bikelanes 55th-63rd programmed in 96
Walnut, 30th to 47th - Rebuild, same laneage	Drainage, curb & gutter, pavement	30th - 33rd completed; 33rd - 47th programmed in 97
Lookout Road, 66th to 71st - Add center turn lane, bike lane, add ped facilities.	LOS	Study underway; programmed in 96
U.S. 36, Kalmia to Violet - Add 2 lanes	LOS	Project scope revised (See Chapter 7)
U.S. 36 / Colorado Ave. / Frontage Rd. intersection	LOS	Project deleted - no longer needed
Pearl Street, 55th to 63rd - First 2 lanes	LOS	Project scope revised (See Chapter 7)
Alley paving	Air pollution control, high maintenance	Continuing work

TABLE 6-2. REVIEW: 1989 TMP TABLE 2.6

"PROJECTS REQUIRED TO ACCOMMODATE TRAFFIC GROWTH"

{based on 1989 TMP Table 2.6}	**Project Status (see Chapter 7 for details)**
Broadway, Norwood to Violet - Add three lanes	Partially Complete - Requires Reassessment
Broadway, Violet to U.S. 36 - Add center turn lanes	DONE
Pearl / 28th Intersection - Add 2 turn lanes	Programmed in 97
Arapahoe / 30th - Northbound right turn lanes	Not Programmed
63rd, Habitat to Jay - Add 2 turn lanes & bike lanes	Programmed in 95
Lookout, Spine to 71st - Add two lanes and bike lanes	Not Programmed
Arapahoe, 63rd to 75th - Add two lanes	Not Programmed
Foothills / Arapahoe interchange	Not Programmed
Foothills / Baseline interchange	Not Programmed
Diagonal / Jay interchange	Not Programmed
Diaganol / 63rd interchange	Not Programmed
Pearl Extension, 55th to 63rd - Add two of four lanes	Programmed in 96, 97, 98, 99
Foothills / Pearl intersection - Add 3 turn lanes	Not Programmed
Jay, 28th to diagonal - Rebuild street to standard section	Partially Complete, Programmed in 96
Foothills / Valmont interchange	Not Programmed
Foothills / Colorado interchange	Not Programmed
Pearl, 30th to Foothills - Add 2 lanes	Not Programmed
Canyon / Folsom intersection - Add east / west left turns	Not Programmed
30th / Pearl intersection - Add 4 lanes	Not Programmed
Turning lanes, new signals, signal upgrades, safety projects, street lights, $150,000 / year	Work Continuing
County Projects, Priority Set by County	
75th / 76th intersection - Realign	Revised Plan, Done
Arapahoe / 75th intersection - Add north-south turn lane	Not Programmed

About $22 million in existing needs was identified including over $5 million attributable to increased travel by existing residents. Another $50 million in anticipated growth-induced needs was identified in the '89 TMP Table 2.6.

The status of these original TMP projects is shown in Tables 6-1 and 6-2 above.

TMP update roadway projects

The yet-to-be-completed projects in these lists provided a starting point for evaluation in this Update of roadway-related needs between now and 2020. Several issues with respect to the 1989 project lists have been addressed.

These included:

- Does the traffic forecast under Scenario D still warrant the proposed investment?
- Is the project part of a multimodal corridor?
- What functional category does the proposed improvement fall into?

The public identifies the problem associated with increased traffic as "congestion." This section opened with a discussion of level of service which is one measure of congestion.

The principle physical cause of congestion is the fact that roads and streets intersect. Were it not for intersections, our roads would be capable of carrying far more vehicles per hour than than they can today. (Of course, a city without intersections would not be much of a place to live.)

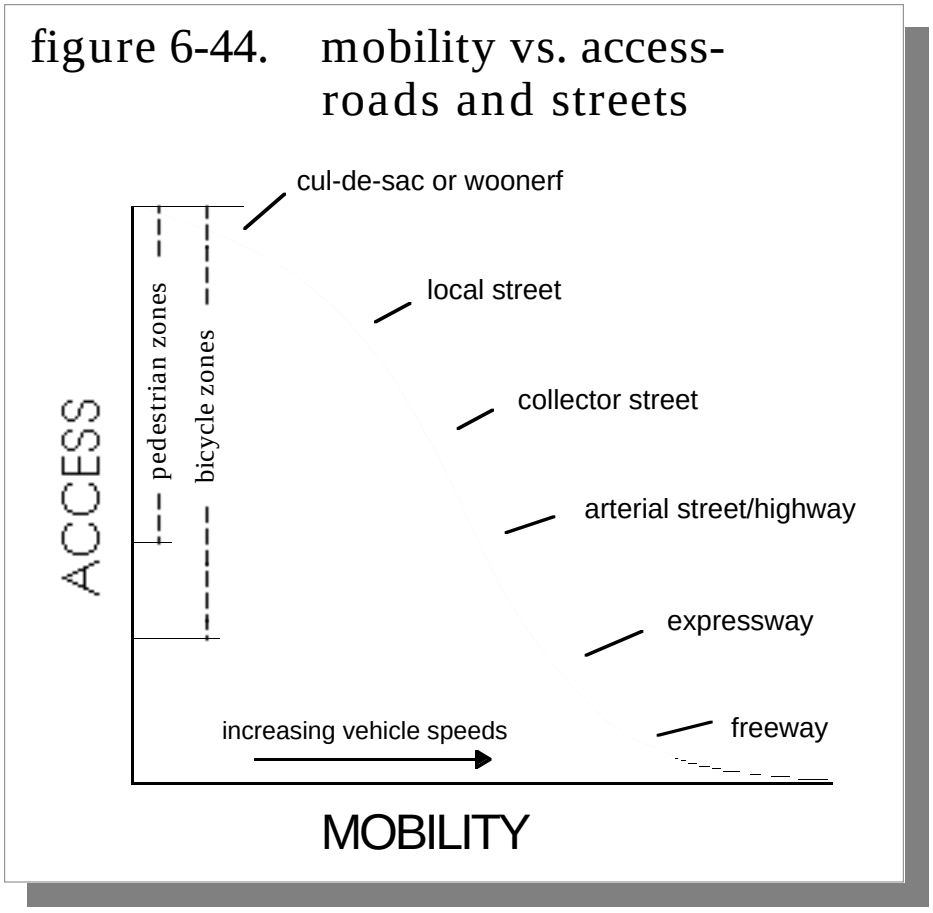
Another fact about intersections is that they are barriers to all modes. Not only autos, but buses, bicyclists and pedestrians are delayed at intersections.

Clearly, it is the intersection which must be addressed if congestion is to be reduced. However, this does not mean that interchanges are the answer, since they are useful for auto travel but greatly impede bicycling and walking. This fact, combined with the impact intersections have on surrounding land uses and community character have caused the City to conclude that major new roadway interchanges are not a high priority for this TMP Update.

Finally, in addressing congestion, it is important to recognize that Boulder is a regional center - a city with high environmental values. As a destination and place to live, it derives value from accessibility.

By contrast, Boulder gains little value from serving as a conduit for vehicle trips passing through to other places. Giving local access a higher priority than throughput mobility without decreasing personal travel by other modes requires increasing alternative modes activity and limiting VMT growth.

figure 6-44. mobility vs. access- roads and streets



However, efficiency of personal travel within Boulder is important - and the capability to travel between neighboring communities and Boulder is important. The overall motor vehicle circulation strategy embodied in this TMP Update is to improve the efficiency of existing roadways before building new ones.

Much of the roadway investment program described in Chapter 7 is targeted at improving the capability for travel by all modes on Boulder streets. This includes an emphasis on intersection improvements. Not included are new roadways on new alignment, new interchanges and new through lanes.

traffic signal timing

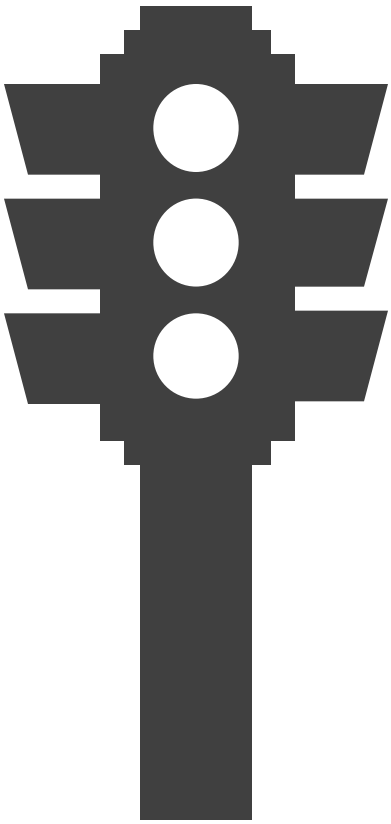
One of the concerns expressed most frequently about driving in Boulder is the timing and sequencing of traffic signals.

People who have lived in other communities recall driving down long arterial corridors where lights were timed in a sequence that matched the speed limits so that traffic seemed to flow steadily through intersections with only occasional stops.

People who have lived in Boulder a long time recall the days when there were fewer traffic signals and less traffic, and a drive across town might involve stopping at only two signals.

Both groups are frustrated by driving in Boulder today.

What the future holds is both "good news" and "bad news." On the good news side, there are positive things that can be done to improve flows.



This TMP Update places a significant financial emphasis on intersections in the roadway investments program (Chapter 7). Improving our intersections to make them function more efficiently will improve flows and reduce conflicts - for all modes.

The City is also completing a major three-year comprehensive upgrade of its signal timing equipment and central computer. This work will be completed over the next year and will provide more flexibility to address problem intersections.

On the bad news side, there are inherent conflicts in our local street network and traffic patterns which cannot be solved in a way that would please all drivers. Further, if the underlying objective of this TMP Update (no long-term growth in vehicular traffic) is not achieved, the congestion at signalized intersections will get worse - perhaps much worse - regardless of any signal timing or intersection improvements.

The City of Boulder's approach to this issue has been: **traffic signal timing should be designed to maximize the overall efficiency of the system by minimizing total delay for all vehicles.**

This approach makes sense for efficiency and fairness, and for air quality. Alternative timing schemes which maximize traffic flow rates on specific corridors would make the drivers on those facilities happier -- but at the expense of all other drivers. And, daily air pollution emissions from motor vehicles, especially of carbon monoxide, would be higher if total delay increased as a result.

Boulder is a compact city with a somewhat more urban character than most cities its size (and larger). The street grid is more fine-grained than the street networks in sprawled-out suburban-style communities.

Autos are entering the main streets from numerous side streets, pedestrians are trying to cross, and bicyclists are present.

Traffic signals are encountered frequently, especially along major arterial corridors. The stretch of 28th Street near Crossroads traverses four intersections with heavy cross-street traffic (Arapahoe, Canyon, Walnut, and Pearl) within a very short distance. Boulder has 127 signals today. If the TMP Update "no growth in traffic" objective is not achieved, this could potentially grow to as many as 170 signals.

Traffic flows are balanced directionally on much of the local street system. This means that, with the exception of south US 36, the Diagonal and certain other streets at the fringe of the City, northbound-southbound traffic and eastbound-westbound traffic is fairly balanced, even during peak travel periods. This means that, at most intersections, there are queues of vehicles moving in every direction -- all of which need to be accommodated.

Where flows are heavily directional at certain times of the day, it is possible to bias the system toward those directions and sequence the signals to provide a "progression" through the corridor.

Even with balanced directional flows, some sequencing of signals is possible. There are corridors in Boulder where progressions can occur during much of the day.

However, as traffic grows and intersections reach or exceed capacity, there is no way to maintain continuous corridor progressions. As traffic increases, speeds drop, queues get longer and the time required to clear each signal increases. Especially where signalized intersections are close together, the signal sequencing and progressions will "break down" in peak traffic periods.

We all, as drivers, wish we could get a green light to turn onto the main street from our side street, and then proceed on our way without stopping again. We would all like to make it through the signals on Broadway and on 28th Street without stopping more than once. It is important to understand that there is no signal timing scheme that will make this possible.

What the City can and should do is continue to invest in its intersections and to improve its signal timing system so that traffic can flow more efficiently. These are likely to be incremental improvements.

If traffic continues to grow, these incremental improvements, while still important, will be barely noticeable in the face of greater congestion.

development review principles

The City's Planning Department has established several principles used to guide the development review process in order to ensure that new developments build "good roads" which provide access and mobility for all modes.

These principles are:

- All new streets shall be open to public access. Their design will ensure connectivity and accessibility for all citizens. Their construction will meet high quality standards to ensure public health, safety and welfare and to minimize future expenditures required for maintenance and reconstruction.

- In addition to providing mobility, public streets should provide other community amenities including: landscape buffers; attractive public spaces; opportunities for

citizen interaction; public art, view corridors; and potential avenues for new technologies.

- Developments must take access where they least affect the capacity and safety of arterials or collectors and where they least impact neighborhoods.

- A street may not be regarded as a private driveway unless all of the following criteria are met: Four or fewer living units are serviced by the street; The street is a dead end (no loop or through circulation for automobiles); and the street is less than 100 feet in length.

- All new streets or streets converting from private streets to public streets shall, at a minimum, meet the standards contained in the City of Boulder Standards Specification and Design Criteria Manual.

- All cul-de-sacs in new developments should provide an outlet for alternative mode access to other elements of the transportation system.

- The City's roadway network shall be based on a grid system and designed to maximize access and connectivity rather than vehicular speed.

revised level of service objective

In the 1989 TMP, the City established the objective of maintaining a level of service D (LOS D) on all roadways.

The 1989 TMP objective said that:

"The City shall strive to maintain an acceptable level of service on roads, which generally corresponds to LOS D or better as defined by the Highway Capacity Manual (Transportation Research Board, 1985)."
The objective of maintaining level of service D (LOS D) on all roadways in Boulder has not been met, and would not be met in the future under any scenario studied in this Update. Under Scenarios A and B, over 60% of Boulder's arterial streets would reach LOS F by 2020.

Yet, congestion is an important measure of the performance of the system, and a major reason the City has adopted a "no growth in traffic" objective is because it is trying to prevent increases in traffic congestion.

The City will continue to use level of service (LOS) D as an important measure of how the transportation system functions and to help determine the success of demand management and other programs designed to prevent increases in traffic congestion. However, the City will not continue to use maintenance of LOS D as the primary objective of the transportation system.

Instead, this TMP Update replaces the LOS D objective with the objective of preventing increases in traffic congestion (LOS F). Currently, about 16% of Boulder's arterials are congested. The TMP Update objective is: "no more than 20% of roadways congested at LOS F."